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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/678,479	10/03/2003	Vladimir Tsukanov	011775-013410US	1443

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TOWNSEND AND TOWNSEND AND CREW, LLP
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

EXAMINER	
VU, DAVID	

ART UNIT	PAPER NUMBER
2818	

DATE MAILED: 03/21/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/678,479	TSUKANOV ET AL.
	Examiner	Art Unit
	DAVID VU	2818

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 January 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5; 7-24 and 28-30* is/are pending in the application.

4a) Of the above claim(s) *6 and 25-27* is/are withdrawn from consideration.

5)☒ Claim(s) *28-30* is/are allowed.

6)☒ Claim(s) *1-5 and 7-22* is/are rejected.

7)☒ Claim(s) *23-24* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *06 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

1. Claims 1, 2, 4-5, 8-11 and 15-16 are rejected under 35 U. S. C. 102(b) as being anticipated by Hshieh et al. (US Pat. 5,629,543, herein after Hshieh '543).

Regarding claim 1, 4-5 and 16, Hshieh '543 discloses a power semiconductor device, comprising: a substrate having an upper surface and a lower surface, the substrate having a trench; first and second doped regions 14/18 provided proximate the upper surface of the substrate; a first source region 20 provided within the first doped region 14; a second source region 20 provided within the second doped region 18; and a gate 30A/30B provided between the first and second source regions (fig. 3F), the gate including a first portion extending laterally within the trench, wherein a depth of the trench is no more than a depth of the first doped region, wherein the gate has a lateral extension (2 microns) (col. 4, line 49) greater than vertical extension (1.7 microns) (col. 4, lines 22-23). Note that the intended use limitation "to reduce the curvature of equi-potential lines... " does not distinguish over the structure of Hshieh '543 (fig. 3F).

Regarding claim 2, Hshieh '543 discloses a drain region 46 provided proximate the lower surface of the substrate (col. 4, lines 60-63).

Regarding claims 8-9, Hshieh '543 discloses the depth of the trench is 1.7 microns (no more than about 2.5 micron) (col. 4, lines 22-23).

Regarding claim 10, Hshieh '543 discloses the first portion of the gate includes a planar portion (channel region) that is substantially parallel to the upper surface of the substrate (fig. 3F).

Regarding claim 11, Hshieh '543 discloses the planar portion is about 1-2 micron (col. 3, line 49).

Regarding claim 15, Hshieh '543 discloses the device is a power DMOSFET (Abstract).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later

invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

2. Claims 19, 20 and 22 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Hshieh (US Pat. 5,629,543).

Regarding claims 7-8, 12-14 and 17-22, Hshieh '543 discloses a power semiconductor device, comprising: a substrate having an upper surface and a lower surface, the substrate having a trench; first and second doped regions 14/18 provided proximate the upper surface of the substrate; a first source region 20 provided within the first doped region 14; a second source region 20 provided within the second doped region 18; and a gate 30A/30B provided between the first and second source regions (fig. 3F), the gate including a first portion extending laterally within the trench, wherein a depth of the trench is no more than a depth of the first doped region, wherein the gate has a lateral extension (2 microns) (col. 4, line 49) greater than vertical extension (1.7 microns) (col. 4, lines 22-23) {See also **Takeuchi et al.** (US Pat. 6,133,587) (col. 8; lines 47-54 and fig. 14) for evidence of the state of the art in which the hexagonal cell structure comprises a gate including a first portion provided within the shallow trench and a second portion provide outside of the trench}.

Hshieh fails to disclose a length of the first portion of the gate is greater than the depth of the trench a ratio of a length of the first portion of the gate to the depth of the trench is about 2.5:1. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Hshieh '543 by ratio about 2.5:1 because the width/depth ratio would be a matter of mere routine optimization to select which are best for the process of forming a power

semiconductor device and since the specification contains no disclosure of either the critical nature of the claimed device (i.e. - a ratio of a length of the first portion of the gate to the depth of the trench is at least 1.5:1; 2.5:1) or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen limitations or upon another variable recited in a claim, the Applicant must show that the chosen limitation are critical. *In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990).

Regarding claim 20, Hshieh '543 discloses the depth of the trench (col. 4, lines 22-23) is no more than the depth of the doped region 14 (col. 4, lines 11-14 and fig. 3F) and a drain region 46 provided proximate the lower surface of the substrate (col. 4, lines 60-63).

Regarding claims 8, 12-14, 18 and 21, Hshieh '543 discloses the depth of the first doped region 14 is 7 microns (col. 4, lines 11-14) but fails to disclose the depth of the first doped region is no more than about 5 microns and the planar portion of the gate is about 1-2 micron (col. 3, line 49). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Hshieh '543 device because the width and depth would be a matter of mere routine optimization to select which are best for the process of forming a power semiconductor device and since the specification contains no disclosure of either the critical nature of the claimed device or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen limitations or upon another variable recited in a claim, the Applicant must show that the chosen limitation are critical. *In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990).

3. Claim 3 is rejected under 35 U.S.C. 103 (a) as being unpatentable over Hshieh et al. (US Pat. 5,629,543) in view of Takeuchi et al. (US Pat. 6,133,587, herein after Takeuchi)

Hshieh '543 teaches a power semiconductor device as describe above but fails to disclose the gate further comprises a second portion provided overlying the substrate and extending toward the first source region. However, Takeuchi teaches the gate structure including a first portion provided within the shallow trench and a second portion provide outside of the trench (col. 8; lines 47-54 and fig. 14). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have substituted gate structure such as taught by Takeuchi in place of the gate structure of Hshieh device, because it would have been a mere substitution of well known art recognized equivalent gate structure for provide electrical contact.

Allowable Subject Matter

4. Claims 23 and 24 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

5. Claims 28-30 are allowed.

The following is a statement of reasons for the indication of allowable subject matter: The prior art of record, either singularly or in combination, does not disclose or suggest an Applicant's claimed method for fabricating a power semiconductor device, particularly characterized by: "forming the shallow trench includes: etching the substrate to form an

intermediate trench having a third depth that is less than the first depth; forming a first oxide layer within the intermediate layer; and removing the oxide layer formed within the intermediate trench, wherein a resulting trench from the removal of the oxide layer has a fourth depth that is greater than the third depth."

Response to Arguments

6. Applicant's arguments with respect to claims 1-5 and 7-24 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).
A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David Vu whose telephone number is (571) 272-1798. The examiner can normally be reached on Monday-Friday from 8:00am to 5:00pm. If attempt to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms can be reached on (571) 272-1787. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR, Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

David Vu

March 03, 2005.

David Nelms
Supervisory Patent Examiner
Technology Center 2800